इंटरनेट मानक

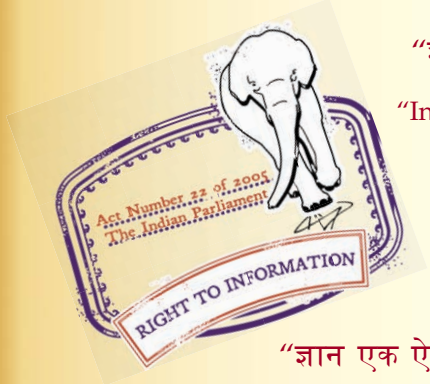
Disclosure to Promote the Right To Information

Whereas the Parliament of India has set out to provide a practical regime of right to information for citizens to secure access to information under the control of public authorities, in order to promote transparency and accountability in the working of every public authority, and whereas the attached publication of the Bureau of Indian Standards is of particular interest to the public, particularly disadvantaged communities and those engaged in the pursuit of education and knowledge, the attached public safety standard is made available to promote the timely dissemination of this information in an accurate manner to the public.

"जानने का अधिकार, जीने का अधिकार"
Mazdoor Kisan Shakti Sangathan
"The Right to Information, The Right to Live"

"पुराने को छोड नये के तरफ"
Jawaharlal Nehru
"Step Out From the Old to the New"

IS 8198-8 (1993): Code of practice for steel cylinders for compressed gases, Part 8: Common organic refrigerant gases [MED 16: Gas Cylinders]



"ज्ञान से एक नये भारत का निर्माण"
Satyanarayan Gangaram Pitroda
"Invent a New India Using Knowledge"

"ज्ञान एक ऐसा खजाना है जो कभी चुराया नहीं जा सकता है"
Bhartṛhari—Nītiśatakam
"Knowledge is such a treasure which cannot be stolen"

BLANK PAGE

IS 8198 (Part 8) : 1993

(Reaffirmed 1998)

भारतीय मानक

संपीडित गैसों के लिए इस्पात सिलिंडरों की रीति संहिता

भाग 8 सामान्य कार्बनिक प्रशीतन गैस

(पहला पुनरीक्षण)

Indian Standard

CODE OF PRACTICE FOR STEEL CYLINDERS FOR COMPRESSED GASES

PART 8 COMMON ORGANIC REFRIGERANT GASES

(First Revision)

UDC 621·642·02 [669·14] : 621·564 : 006·76

BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

May 1993

Price Group 4

FOREWORD

This Indian Standard (Part 8) (First Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Gas Cylinders Sectional Committee had been approved by the Mechanical Engineering Division Council.

For safe handling of cylinders containing compressed gases, one should be thoroughly conversant with the properties and characteristics of these gases. There are several precautions and safe practices which are to be observed on account of the nature of the gas and also because of the pressure to which the cylinders are subjected.

Manufacturers, fillers and users of the gas cylinders covered by this standard should be familiar with the precautions laid down in this standard in order to ensure safe and efficient operating conditions. For general information on different gases conveyed in cylinders, SP 9 : 1973 'Technical data sheet for gases conveyed in cylinders' may also be referred to.

For the purpose of easy reference the standard is being issued in different parts as under:

Part 1 Atmospheric gases
Part 2 Hydrogen gas
Part 3 High pressure liquefiable gases
Part 4 Dissolved acetylene gas
Part 5 Liquefied petroleum gas (LPG)
Part 6 Liquefied chlorine gas
Part 7 Ammonia gas
Part 8 Common organic refrigerant gases
Part 9 Sulphur dioxide gas
Part 10 Methyl bromide gas
Part 11 Methyl chloride gas
Part 12 Gases for medical use

A refrigerant gas should be one that liquefies easily under pressure, for it works by being compressed to a liquid mechanically and then by absorbing large amounts of heat as it circulates through cooling coils and vaporises back into gas.

The earliest widely used refrigerant had been dry or anhydrous ammonia which liquefied under low pressure. Among the most popular refrigerant gases in the field today are the fluorocarbons, a family of almost indefinitely large size since they are any of the endless series of hydrocarbons which have been fluorinated. Fluorocarbons serve well as refrigerants because most of them are chemically inert to a large extent and they can be selected, mixed or compounded to provide almost any physical properties desired in particular refrigerant applications.

The quantities in this standard have been expressed in technical metric units. However, in view of the introdution of International System (SI) units in the country, the relevant SI units and the corresponding conversion factors are given below for guidance:

$1\ kgf/cm^2 = 98{\cdot}066\ 5\ kPa$ (kilopascal)
$= 0{\cdot}098\ 066\ 5\ MPa$ (megapascal)
$= 0{\cdot}980\ 665$ bar

The fluorocarbons constitute a large family of fluorinated hydrocarbon compounds that exhibit similar chemical properties and wide range of physical characteristics. This standard covers in general only some of the most widely used fluorocarbons, their quality specifications, cylinder filling, inspection and testing procedures and recommended practices on storage and handling.

(*Continued on third cover*)

Indian Standard

CODE OF PRACTICE FOR STEEL CYLINDERS FOR COMPRESSED GASES

PART 8 COMMON ORGANIC REFRIGERANT GASES

(First Revision)

1 SCOPE

1.1 This standard (Part 8) covers the physical properties, filling, periodic inspection and testing, handling and usage of common refrigerant gases in cylinders of nominal capacity up to and including 130 litres water capacity. Five refrigerant gases R12, R13, R22, R115 and R500 are covered.

2 REFERENCE

The Indian Standards given in Annex A are necessary adjuncts to this standard.

3 TERMINOLOGY

3.1 For the purpose of this standard, the following definitions in addition to those given in IS 7241 : 1981 shall apply.

3.1.1 *Refrigerant*

The medium for conveying heat in a refrigerating system, being evaporated by absorbing heat at a lower temperature, and liquefied by surrendering heat at a higher temperature.

3.1.2 *Compound*

A substance formed by the union of two or more elements in definite proportions by mass.

3.1.3 *Hydrocarbon*

A compound containing only the elements hydrogen and carbon.

3.1.4 *Halocarbon*

A halogenated hydrocarbon containing one or more of the following four halogens:

fluorine, chlorine, bromine and iodinc.

3.1.4.1 *Fluorocarbons*

Fluorocarbons are, in general produced commercially by the reaction of hydrofluoric acid with chloro carbons or by the disproportionation of other fluorocarbons.

3.1.5 *Isomer*

One of a group of compounds having the same combinations of elements, but arranged spatially in different ways.

3.1.6 *Mixture*

A complex of two or more compounds which do not bear a fixed proportion to one another, and which however thoroughly mixed together, retains a separate existence.

3.1.7 *Azeotrope*

A mixture of refrigerants whose vapour and liquid phases have identical compositions at a given temperature.

4 NUMBERING SYSTEM, DESIGNATION

4.1 The numbering system of organic refrigerants is covered in IS 10609 : 1983. An identifying number is assigned to an organic refrigerant such that the structure of the compounds may be deduced from the refrigerant numbers and *vice versa* without ambiguity. The rules of the fixed number systems are as follows.

4.1.1 The first digit on the right is the number of fluorine (F) atoms in the compound.

4.1.2 The second digit from the right is one more than the number of hydrogen (H) atoms in the compound.

4.1.3 The third digit from the right is one less than the number of carbon (C) atoms in the compound. When this digit is zero it is omitted from the number.

4.1.4 The number of chlorine (Cl) atoms in the compound is found by subtracting the sum of the fluorine (F) and Hydrogen (H) atoms from the total number of atoms which can bc connected to the carbon (C) atoms.

4.1.4.1 For saturated hydrocarbons, the total number of atoms attached to the carbon atoms are as follows:

For 1C, the total number of atoms is 4.
For 2C, the total number of atoms is 6.
For 3C, the total number of atoms is 8.
For n.c., the total number of atoms is 2n+2.

4.1.4.2 For unsaturated hydrocarbons, the total number of attached atoms are as follows:

For 2C, the total number of atoms is 4.
For 3C, the total number of atoms is 6.
For n.c., the total number of atoms is 2n.

4.2 The identifying number is preceded by the letter symbol 'R' or used in combination with the word 'Refrigerant'.

Thus R12 signifies an organic refrigerant with 2 fluorine (F) atoms, no hydrogen (H) atom and 1 carbon (C) atom. The total number of atoms attached to the carbon atom being 4, the number of chlorine atoms shall be 4 - 2 = 2.

The chemical formula is CCl_2F_2 and the chemical name Dichlorodifluoromethane.

4.3 Mixtures are designated by their respective refrigerant numbers and mass proportions. Refrigerants are named in order of increasing boiling points. For example, a 90 percent and 10 percent mixture of refrigerants 22 and 12 will be indicated as R 22/12 (90/10), or R 22/R 12 (90/10), or Refrigerant 22/Refrigerant 12 (90/10).

4.4 Arbitrary

Identifying numbers of the 500 series are assigned to azeotropes. Refrigerants should be named in increasing order of boiling points.

5 PHYSICAL PROPERTIES AND QUALITY REQUIREMENTS OF COMMON ORGANIC REFRIGERANTS

5.1 Physical Properties

The physical properties of some commonly used organic refrigerants are given in Table 1.

Table 1 Physical Properties of Commonly Used Organic Refrigerants

Sl No.	Particulars	Refrigerant Gas				
		R12	R13	R22	R115	R500
i)	Chemical symbol	CCl_2F_2	$CClF_3$	$CHCl_2F_2$	$CClF_2CF_3$	—
ii)	Chemical name	Dichloro-difluoro-methane	Monochloro-trifluoro-methane	Monochloro-difluoro-methane	Monochloro-pentafluoro-ethane	Refrigerant gas mixture with 73.8% of R12 and 26.2% of R152a by mass
iii)	Molecular mass	120.93	104.47	86.48	154.48	99.29
iv)	Saturated vapour pressure kgf/cm^2 at 65°C	16.29	125.17	26.71	22.48	19.58
v)	Density saturated vapour at boiling point, kg/m^3	6.26	7.013	4.82	8.358	5.22
vi)	Density, liquid at 15°C, g/ml	1.346	0.99	1.231	1.334	1.189
vii)	Filling ratio	1.08	0.91	0.90	1.00	0.94
viii)	Boiling point at 760 torr	-30.5°C	-81.4°C	-40.8°C	-38.7°C	-33.3°C
ix)	Freezing point at 1 atm	-157.8°C	-181.1°C	-160°C	-106°C	-158.9°C
x)	Critical temperature	111.5°C	28.9°C	96°C	79.9°C	105°C
xi)	Critical pressure kgf/cm^2	41.96	39.44	50.75	31.85	44.36
xii)	Latent heat of vaporization at boiling point kcal/kg	39.5	35.5	55.85	30.14	—
xiii)	Specific heat, liquid at 25°C cal/g	0.232	—	0.300	0.282	—
xiv)	Specific heat ratio, C_p/C_v at 25°C and 1 atm	1.137	1.145	1.184	1.091	—
xv)	Mass per m^3 liquid at 21°C in tonnes	1.110	0.752	1.008	1.090	—

5.2 Quality Requirements

The quality of the fluorocarbons should be very carefully controlled during manufacture and packaging. The desirable quality requirements which will limit the impurities present in refrigerants are given in Table 2.

5.2.1 *Analytical Methods*

A short description of the analytical methods which may be used as a lead by the repackers is given in Annex B (*see also* IS 5610 : 1983). A detailed description of process is beyond the scope of this standard.

6 APPROVED SPECIFICATIONS OF CYLINDERS AND VALVE FITTINGS

6.1 Refrigerants R12, R22, R115 and R500 pertain to the low pressure liquefiable group whereas refrigerant R13 comes under the high pressure liquefiable category.

6.2 The cylinders used for storage and transportation of refrigerants R12, R22, R115 and R500 shall conform to one of the specifications approved by the statutory authority. A list of approved specifications is given in Annex C.

6.3 The cylinders used for the storage and transportation of refrigerant R13 shall conform to one of the specifications approved by the statutory authority. A list of approved specifications is given in Annex D.

6.4 The valves fitted to the cylinders shall conform to IS 3224 : 1979. Valve outlet No. 5 has been specified for cylinders containing refrigerants R12, R13 and R22.

7 FILLING

7.1 Inspection Before Filling

Before filling any cylinder, the filler shall subject it to a thorough examination to ensure that:

a) the cylinder is manufactured to a specification approved by the statutory authority and fitted with approved type of valves as mentioned under **5**;

b) the cylinder is not due for periodic inspection and retesting as required under **7** which will be indicated from the markings on the cylinder;

c) all statutory requirements in respect of markings and painting are complied with;

d) the valve and its parts including outlet threads are in good condition; and

e) the external condition of the cylinder body is sound. Any defect such as dent, bulge, cut, gouge, corrosion, etc, which is liable to weaken the cylinder wall as certified by a competent person will render the vessel unfit for further use. The acceptability limit of such damaged cylinder is specified in IS 5845 : 1993 for cylinders containing refrigerants R12, R22, R115 and R500, and in IS 8451 : 1981, for cylinder containing refrigerant R13.

Table 2 Quality Requirements of Common Organic Refrigerants
(*Clause* 5.2)

Sl No.	Characteristic	Refrigerant Gas				
		R12	R13	R22	R115	R500
i)	Appearance	C & F	C & F	C & F	C & F	C & F
ii)	Maximum water content, mg/kg	10	10	10	10	10
iii)	Maximum non-absorbable gas, percent by vol in vapour	1.5	1.5	1.5	1.5	1.5
iv)	Approximate boiling point at atmospheric pressure, °C	-29.8	-81.4	-40.8	-38.7	-33.3
v)	Maximum boiling range, from 5 to 85 percent evaporation, °C	0.3	0.3	0.3	0.3	0.3
vi)	Maximum residue on evaporation, mg/kg	50	50	50	50	50
vii)	Chloride ion content	ND	ND	ND	ND	ND

C & F = Clear and essentially free from suspended matter.

ND = Non detectable.

7.2 Cylinders for organic refrigerant gases shall not be filled in excess of the filling ratio specified by the statutory authority (*see also* IS 3710 : 1978 for R12, R22, R115 and R500 gases, and IS 8866 : 1978 for R13 gas) based on the design of the cylinder and the type of liquefied gas being filled. The amount of gas charged into the cylinder shall be determined by weighing. The weight shall be checked after the cylinder has been disconnected from the charging line.

7.3 All cylinders shall be carefully examined for leaks.

7.4 Refrigerant gas cylinders returned for filling shall be sprayed with a little liquid content from the cylinder on a clean 20 cm × 20 cm mirror and the odour of the evaporating gas shall be checked. The cylinder shall not be accepted if unusual odour is observed. The mirror shall be thereafter carefully examined on the surface for oil, solid particles, etc. If traces of contaminants are found the cylinder shall not be accepted for filling but shall be subjected to interior inspection as mentioned under **8**.

7.5 Cylinders which pass the test prescribed in **7.3** may be refilled without removing the remaining product from the cylinder with the same refrigerant gas it had originally contained after filling. Leaks may be detected with soap water solution. Before a cylinder leaves any filling station, the filler shall ensure that the valve is in fully closed position. Where leaks cannot be stopped by tightening gland nut or spindle, the cylinders shall be emptied and inspected for the cause of leakage.

7.6 Emptying a gas cylinder for liquefiable gas or transferring of gas from one cylinder to another shall not be accelerated by direct heating of the cylinder with open flame. The heating shall be done only in a water bath. A full cylinder shall not be placed in a water bath.

7.7 Cylinders shall be filled in an approved filling station only.

7.8 To avoid filling cylinders with wrong gas inadvertently, receipt, examination and filling of various gas cylinders shall be isolated from each other.

7.9 Care shall be taken not to introduce air, moisture or other contaminants during filling.

8 PERIODIC INSPECTION AND HYDRAULIC TESTING

8.1 Cylinders are subjected to periodic inspection and testing to ensure that they are safe for further use. In the case of organic refrigerant gases the periodic inspection interval is not to exceed 5 years (*see* IS 8868 : 1988). The periodic inspection shall be carried out according to **8.1.1** to **8.1.4**.

8.1.1 *Visual Inspection*

To be acceptable cylinders shall satisfy the requirements of external and internal examination inaccordance with IS 5845 : 1993 for R12, R22, R115 and R500, and in accordance with IS 8451 : 1981 for R13.

8.1.2 *Hydrostatic Test*

In the case of R12, R22, R115 and R500 the test pressure shall be retained for a period not less than 30 seconds. Any reduction in pressure noticed during this retention period or any leakage, visible bulge or deformation shall be treated as a case of failure of the test. In all cases, the inside of the cylinder shall be dried after carrying out hydrostatic test before filling. In the cases of R13 gas hydrostatic test shall be substituted by hydrostatic stretch test in accordance with IS 5844 : 1970.

8.1.3 *Weighing*

Cylinders shall be weighed and if the tare is less than 95 percent of the original tare marked on the cylinder, the cylinder shall be condemned.

8.1.4 *Checking of Valves*

Prior to the hydrostatic test, the valves shall be removed and the threads examined for distortion and suitability of re-use. Valves or parts of the valves which are not in serviceable condition shall be reconditioned or renewed as necessary.

8.2 Periodic inspection shall also be carried out on cylinders whenever special circumstances necessitate it, as for instance, when the cylinder shows a serious damage or it is exposed to fire.

8.3 The testing of the cylinders shall be done by a competent person.

9 PAINTING

9.1 The cylinders shall be painted with the colour specified in Gas Cylinder Rules. The colour of the paint of the cylinders shall always be maintained by periodically repainting them. In this regard IS 4379 : 1981 may also be referred.

9.2 In case of ship cylinders and export cylinders, colour of the paint may not be changed and if repainting is considered necessary the colour may remain the same as that adopted in the country of use.

9.3 For identification purpose, each cylinder shall be stencilled in white at least 50 mm high with the identifying number of the organic refrigerant in two places diametrically opposite to each other on the cylindrical portion close to the shoulder.

10 MARKING AND LABELLING

10.1 Marking

Each cylinder and valve shall be permanently marked according to **10.1.1** and **10.1.2.**

10.1.1 *Marking on Cylinders*

Each cylinder shall be permanently marked at the valve end of the cylinder and off the cylindrical part of the body with following markings:

a) Serial number and identification of the manufacturer;

b) Number of the standard to which the cylinder conforms;

c) Test pressure;

d) The date of hydraulic test with code mark of the station where the test was carried out;

e) Water capacity in litres;

f) A symbol to indicate the nature of heat treatment;

g) Tare mass of cylinder (mass of empty cylinders with valve fitted);

h) Gross mass;

j) Gas symbol; and

k) Working pressure.

10.1.2 *Marking on Cylinder Valves*

a) Number of the standard;

b) Gas symbol;

c) Maximum test pressure; and

d) Manufacturer's symbol and year of the manufacture.

10.2 Labelling

Each filled cylinder shall carry an adhesive label detailing the name of the filling station, its location, name of the gas and the warning instruction as stipulated in the Gas Cylinder Rules.

10.2.1 Adhesive label shall be so pasted on the cylinder that it does not cover the markings on the cylinder shoulder.

11 HANDLING AND USE

11.1 The gas shall be called by its identification number. Cylinders shall never be used without ascertaining the gas it contains.

11.2 Markings, labels and stencilled marks used for identification of contents of cylinders shall not be defaced or removed.

11.3 Adequate care shall be taken in handling cylinders so that these are not dropped or struck against each other violently. Trolleys and cradles shall be used while moving cylinders.

11.4 Cylinders shall never be used as rollers, supports or any purpose other than for which they are intended.

11.5 Cylinders shall not be lifted with an electromagnet.

11.6 Cylinders shall not be left close near a source of heat or kept in contact with an electric wire or fitting so that it may become path of an electric circuit.

11.7 For piping, copper with silver soldered fittings is often used for lines of 25 mm diameter or less and stainless steel with welded joints for larger lines. Screwed fittings shall not be used. Teflon is amongst the materials recommended for gaskets in flanged joints.

11.8 Liquid fluorocarbons in contact with the skin can cause severe freezing or frost-bite because of their low temperature. Protective handgloves should be worn at the time of usage.

11.9 Systems using fluorocarbons as refrigerants shall be dry in order to prevent the faulty functioning of components like regulating valves, bellows, diaphragms, hermetically sealed coils or lubricating oils due to the freezing of moisture in those components.

12 STORAGE (AT CONSUMER'S END)

12.1 The storage shall be provided with good natural ventilation at floor level and at eaves level.

12.2 The location of the doors and layout of the store shall be such that the cylinders may be removed easily in the event of a fire. The exits shall be kept free of obstruction.

12.3 Full and empty cylinders shall be kept separated from each other.

12.4 Cylinders shall not be stored near corrosive substances or vapours.

12.5 Cylinders with flat base may be stored upright and a gangway shall be left after every fourth row to permit access and handling of cylinders.

12.6 Cylinder with round base shall be stacked horizontally. If these are to be stacked vertically, suitable stand shall be provided and not propped against walls, benches or other cylinders.

12.7 If cylinders are stacked horizontally, larger cylinder shall be placed at the bottom and positive steps shall be provided to prevent the cylinders from rolling. A gangway shall be provided between neighbouring stacks of cylinders.

12.8 Valves of empty cylinders shall be kept closed at all times.

12.9 Cylinders may be stored in open but in such cases they shall be protected against the extremes of weather and from the ground beneath to prevent rusting.

12.10 Valves of cylinders shall be closed before breaking the outlet connections from them. Cylinders with leakly valve shall never be used.

12.11 Cylinders valves shall be kept closed at all times except when gas is actually being used.

13 TRANSPORTATION

13.1 Cylinders shall not be loaded on vehicles so that they may bounce or strike against each other.

13.2 Cylinders shall not project in the horizontal plane beyond the sides or ends of the vehicles in which they are transported.

13.3 Cylinders on vehicle shall be blocked or braced and secured to prevent movement or falling down.

13.4 There shall not be any sharp projection on the inside of the vehicle which can damage the cylinder wall.

13.5 Lighter cylinder shall be kept on top of the heavier ones during transit.

13.6 A leaky cylinder shall not be transported.

13.7 When cylinders are transported by rail it shall be done in accordance with the Railway Red Tariff Rules.

14 RECORDS

14.1 Filling station shall maintain the following record in respect of each cylinder examined and tested for filling:

a) Permission from statutory authority permitting the use of cylinder;

b) Name of the manufacturer and owner;

c) Cylinder number;

d) Specification to which the cylinder conforms;

e) Date of original hydraulic test;

f) Test reports and certificates furnished by the manufacturer;

g) Test pressure;

h) Maximum working pressure;

j) Water capacity;

k) Date of last hydraulic test and name of testing station;

m) Tare of the cylinder;

n) Identification number of refrigerant;

p) Type of valve fitted; and

q) Mass of gas charged.

ANNEX A

(*Clause* 2)

LIST OF REFERRED INDIAN STANDARDS

IS No.	*Title*
3196 (Part 2) : 1992	Welded low carbon steel gas cylinders exceeding 5 litre water capacity for low pressure liquefiable gases : Part 2 Cylinders for liquefiable gases other than LPG (*fourth revision*)
3224 : 1979	Specification for valve fittings for compressed gas cylinders excluding liquefied petroleum gas (LPG) cylinders (*second revision*)
3710 : 1978	Filling ratios for low pressure liquefiable gases contained in gas cylinders (*first revision*)
4379 : 1981	Identification of the contents of industrial gas cylinders (*first revision*)
5610 : 1983	Specification for chlorofluoro hydro carbons of the methane and ethane series (*first revision*)

IS No.	Title	IS No.	Title
5844 : 1970	Recommendations for hydrostatic stretch testing of compressed gas cylinders	8451 : 1981	Code of practice for visual inspection of high pressure gas cylinders (*first revision*)
5845 : 1993	Code of practice for visual inspection of pressure gas cylinders other than LPG cylinders (*second revision*)	8866 : 1978	Filling ratios and corresponding developed pressure for high pressure liquefiable gases contained in gas cylinders
7142 : 1974	Welded low carbon steel gas cylinders for low pressure liquefiable gases not exceeding 5 litre water capacity	8868 : 1988	Periodic inspection interval for gas cylinders in use (*first revision*)
7241 : 1981	Glossary of terms used in gas cylinder technology (*first revision*)	10609 : 1983	Refrigerant — Number designation

ANNEX B

(*Clause* 5.2.1)

ANALYTICAL METHODS TO EVALUATE QUALITY OF COMMON ORGANIC REFRIGERANTS

B-1 APPEARANCE

B-1.1 Approximate 100 ml is poured in a glass jar which can stand the vapour pressure of the product. Upon visual inspection the liquid shall be clear, colourless arid essentially free from particulate matter.

B-2 WATER CONTENT

B-2.0 The following methods may be employed to determine water content in freon products.

B-2.1 The P_2O_5 Method

By this method the sample is distilled from the sampled cylinder through tared phosphoric anhydride (pentoxide) filled tubes. The gain in mass of the first tube corrected for the average gain or loss in mass of the second and third tubes, gives the mass of water in the sample. The P_2O_5, tubes are always weighed full of dry air. Duration of analysis is 2 hours approx Accuracy is 1 ppm approx.

B-2.2 Electrolytic Moisture Analyser Method

The water from a vaporized sample is absorbed in a phosphoric acid film. A direct current voltage is applied across two platinum electrodes in contact with the acid film and results in the electrolysis of the absorbed water. The current flowing between the electrodes is related to the amount of water present by Faraday's law. Duration of analysis is 30 minutes approx. Accuracy is 0.5 ppm approx.

B-3 NON-ABSORBILITY OF GAS

B-3.1 This is determined by absorbing a measured vapour phase sample in perchloroethylene and measuring the volume of the residual gas. The sample is obtained by directly connecting the absorption apparatus to the vapour phase of the cylinder. Duration of analysis is 3 minutes approx. Accuracy is 0.1 percent approx.

B-4 BOILING POINT AND BOILING RANGE

B-4.1 A precision thermometer is used to measure the boiling point after 5 percent respectively after 85 percent of the sample has been evaporated. The values shall be corrected for change of variation of barometric pressure and for superheating the liquid. The result indicate the boiling point and the boiling range. Duration of the analysis is 15 minutes approx. Accuracy is 0.2°C approx.

B-5 SOLUBLE AND INSOLUBLE RESIDUE

B-5.1 An accurate balance is used to weigh the residue left from a completely evaporated sample.

If the sample appears to be completely free from suspended matter the analysis can be changed to determine the content of soluble residues which shall not exceed 0.005 percent by volume. Advantage is that the check for boiling point and boiling range can be combined with that of residue. Duration of analysis is one and a half hours approx. Accuracy is 1 ppm approx.

B-6 CHLORIDE ION CONTENT

B-6.1 By this method a qualitative check is performed in order to determine if the products are free from chlorine, hydrochloric acid and ionated chlorides. This is done by titration of an alcoholic solution of silver nitrate into the sample. The product passes this test if it remains waterwhite. Duration of analysis is 15 minutes approx.

ANNEX C

(*Clause* 6.2)

LIST OF APPROVED SPECIFICATIONS* FOR GAS CYLINDERS FOR R12, R21, R115 AND R500 GASES

C-1 The list of specifications approved by the statutory authority for use in India is given below:

IS 3196 (Part 2) : 1992 Welded low carbon steel gas cylinders exceeding 5 litre water capacity for low pressure liquefiable gases : Part 2 Cylinders for liquefiable gases other than LPG (*fourth revision*)

IS 7142 : 1974 Welded low carbon steel gas cylinders for low pressure liquefiable gases not exceeding 5 litre water capacity

BS 401 : 1931 Steel cylinders for storage and transport of liquefiable gases. British Standards Institution

* The list is not comprehensive as new specifications are added from time to time. Up-to-date information on the subject can be had from the Chief Controller of Explosives, Nagpur.

ANNEX D

(*Clause* 6.3)

LIST OF APPROVED SPECIFICATIONS* FOR GAS CYLINDERS FOR R13 GAS

D-1 The list of specifications approved by the statutory authority for use in India is given below:

JIS B 8241 : 1968 High pressure gas cylinder. Japanese Industrial Standards Committee.

BS 401 : 1931 Steel cylinders for storage and transport of liquefiable gases. British Standards Institution.

BS 1287 : 1946 High carbon steel gas cylinders for CO_2, N_2O and ethylene. British Standards Institution.

BS 1288 : 1946 Manganese steel gas cylinders for CO_2, N_2O and ethylene. British Standards Institution.

DOT : ICC : 3A : 2015 and above. United States of America. Department of Transport. Interstate Commerce Commission Regulations for the transportation of explosives and other dangerous articles.

DOT : ICC : 3AA : 2015 and above. United States of America. Department of Transport. Interstate Commerce Commission Regulations for the transportation of explosives and other dangerous articles.

* The list is not comprehensive as new specifications are added from time to time. Up-to-date information on the subject can be had from the Chief Controller of Explosives, Nagpur.

(*Continued from second cover*)

Manufacture, possession and use of any gas when contained in cylinders in a compressed or liquefied state is regulated under the Gas Cylinder Rules, 1981 of the Government of India as amended from time to time. Although the standard has been prepared in consultation and agreement with the statutory authorities under these rules, should anything in the code conflict with the provisions of Gas Cylinder Rules, the latter shall be adhered to.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Bureau of Indian Standards

BIS is a statutory institution established under the *Bureau of Indian Standards Act, 1986* to promote harmonious development of the activities of standardization, marking and quality certification of goods and attending to connected matters in the country.

Review of Indian Standards

Amendments are issued to standards as the need arises on the basis of comments. Standards are also reviewed periodically; a standard along with amendments is reaffirmed when such review indicates that no changes are needed; if the review indicates that changes are needed, it is taken up for revision. Users of Indian Standards should ascertain that they are in possession of the latest amendments or edition by referring to the latest issue of 'BIS Handbook' and 'Standards Monthly Additions'. Comments on this Indian Standard may be sent to BIS giving the following reference:

Doc : No. HMD 16 (4547)

Amendments Issued Since Publication

Amend No.	Date of Issue	Text Affected

BUREAU OF INDIAN STANDARDS

Headquarters:

Manak Bhavan, 9 Bahadur Shah Zafar Marg, New Delhi 110002
Telephones : 331 01 31, 331 13 75

Telegrams : Manaksanstha
(Common to all Offices)

Regional Offices:	Telephone
Central : Manak Bhavan, 9 Bahadur Shah Zafar Marg, NEW DELHI 110002	331 01 31, 331 13 75
Eastern : 1/14 C. I. T. Scheme VII M, V. I. P. Road, Maniktola, CALCUTTA 700054	37 84 99, 37 85 61, 37 86 26, 37 86 62
Northern : SCO 445-446, Sector 35-C, CHANDIGARH 160036	53 38 43, 53 16 40, 53 23 84
Southern : C. I. T. Campus, IV Cross Road, MADRAS 600113	235 02 16, 235 04 42, 235 15 19, 235 23 15
Western : Manakalaya, E9 MIDC, Marol, Andheri (East), BOMBAY 400093	632 92 95, 632 78 58, 632 78 91, 632 78 92

Branches : AHMADABAD. BANGALORE. BHOPAL. BHUBANESHWAR. COIMBATORE. FARIDABAD. GHAZIABAD. GUWAHATI. HYDERABAD. JAIPUR. KANPUR. LUCKNOW. PATNA. THIRUVANANTHAPURAM.

Printed at Printrade, New Delhi, India